

A new species of *Monstrilla* (Crustacea: Copepoda: Monstrilloida) from Brazil with notes on *M. brevicornis* Isaac

Eduardo Suárez-Morales and Cristina Dias

(ES-M) El Colegio de la Frontera Sur (ECOSUR), Unidad Chetumal, A.P. 424, Chetumal,
Quintana Roo, 77000. Mexico;

(CD) Universidade Federal do Rio de Janeiro. Inst. de Biologia. Bloco A, Cidade Unversitária,
CEP 21.941-590, Rio de Janeiro, Brazil

Abstract.—*Monstrilla pustulata* n.sp., is described from three adult females collected in the Guanabara Bay system on the coast of Brazil. The new species is similar to *M. brevicornis* Isaac in having a peculiar, conical, horn-like protuberance on the ventral surface near the antennular bases. The new species is compared with the holotype of *M. brevicornis*, from the Java Sea. *Monstrilla pustulata* can be distinguished by its body proportions and details of the antennular armature and swimming legs. However, the most striking feature of this species is its cuticular ornamentation, with a dorsal patch of small, blister-like processes on the head surface and other patches on the cephalothorax and on some pedigerous somites. The original description of *Monstrilla brevicornis* is complemented with new morphological data and is compared with *M. turgida* Scott, also from the Indonesia region. This is the first monstrilloid species described as new from the southwestern Atlantic Ocean.

Monstrilloid copepods are parasites of benthic invertebrates such as polychaetes and molluscs (Isaac 1975, Davis 1984). Adults represent the most conspicuous stage since they are free-living and are frequently captured by plankton nets. However, the group has several taxonomic and nomenclatural problems due to incomplete morphological information about the species (Huys & Boxshall 1991, Grygier 1994a). In order to make a serious revision of the taxonomic status of about 95 species included in this peculiar order of copepods, it is important to have better descriptions than has been the norm for new species and also complementary data for the previously described species. Several species have been redescribed and/or reclassified recently (Grygier 1994b, Suárez-Morales & Riccardi 1997, Suárez-Morales 1999), but much work is still needed, particularly for species in the tropical areas.

An analysis of zooplankton samples col-

lected in 1993 and 1994 in Guanabara Bay, Brazil, yielded several specimens of monstrilloid copepods. Among them we found three females of *Monstrilla* that were identified as a new species. The new species is described herein, following the upgraded standards set by Grygier & Ohtsuka (1995), and it is compared with other related species of *Monstrilla*. The type material is deposited in the Museu Nacional da Universidade Federal do Rio de Janeiro, Brazil.

Monstrilla pustulata, new species Figs. 1A–F; 2A–F

Material.—Holotype adult female, preserved in ethanol, undissected. Guanabara Bay, Rio de Janeiro, Brazil (22°54.604'S, 43°08.988'E), collected 29 Sep 1994. Museu Nacional da Universidade Federal do Rio de Janeiro, Brasil, deposited under catalogue number: MNRJ 13646. Two paratype adult females, same locality, collected

9 Jun 1993, one deposited in the Museu Nacional da Universidade Federal do Rio de Janeiro, Brasil (MNRJ 13647). The other one, collected 4 Jun 1993, deposited in the zooplankton collection of El Colegio de la Frontera Sur, Chetumal, Mexico (ECO-CHZ-00518).

Description.—Female. Body length of three individuals 2.8, 2.67, and 2.83 mm (average: 2.77 mm), measured from anterior end of body to posterior margin of anal somite. Body robust, head widening gradually toward the posterior region of cephalothorax, maximum width at anterior $\frac{1}{3}$, almost same width of posterior margin (Fig. 1A). Cephalothorax swollen ventrally in lateral view. Cephalothorax (incorporating first pedigerous somite) 54% of total body length.

Forehead flat in dorsal view, with two small, slender sensilla widely separated from each other between bases of antennules. Anteriormost part of cephalothorax with ventral, high conical protuberance pointing forward, its height (0.09 mm) similar to that of oral papilla (Fig. 1B). Another cuticular process, formed by a transverse pattern of striations reaches halfway around the cephalothorax (see Fig. 1B). Posterior to this protuberance, and on same ventral surface. Two nipple-like processes lying below and close to conical protuberance, surrounded by patterns of short striations (Fig. 1E). Oral papilla large, protuberant, lying midventrally, about $\frac{1}{3}$ of way from anterior edge of cephalothorax (Fig. 1B). Nauplius eye present, weakly developed, ocelli slightly pigmented on inner edge, with rounded shape. Eyes separated by a distance equal to 1.5 eye diameters.

Dorsal ornamentation of head consisting of large, branched patch of small, rounded blister-like structures arranged in tight pattern. Largest section of this patch on central portion of head, covering area between antennule bases and scattered along both sides of head where two other smaller patches are formed (Fig. 1D). Central cephalic patch extending to posterior part of cephalotho-

rax, and forming a linear, lighter pattern reaching to posterior end of cephalothorax, where it forms a denser patch which stretches to both sides covering the posterior outer margins of the cephalothorax (Fig. 1A), and extending to a ventral patch near the coxae of the first swimming legs. Succeeding five somites (including genital double somite) bearing lateral patches of progressively smaller blisters covering mainly middle portion of outer margins.

Antennule four-segmented; distal segment comprised of segments 4–5 fused. Antennule relatively short, slightly longer than 16% of total body length and about 30% the length of cephalothorax. Proximal three antennular segments with similar length, the distal one is longest; ratio of length of antennule segments as: 18.5: 19.1: 19.2: 43.2 = 100. Armed with 0,I; 1,V; 2,I; 7,X setae (Roman numerals) and spines (Arabic numerals), plus large aesthetasc on proximal part of fourth segment (Fig. 2A). Two of these spines terminal, forming pincer-like structure (Fig. 2B). In terms of pattern described by Grygier & Ohtsuka (1995) for female monstrilloid antennular armature, setae, spines, and aesthetascs on segments 1–4 as: first (1), second (2v₁₋₃, 2d_{1,2}, IId), third (3,IIIv,IIId), and fourth (4aes, 4v₁₋₃, 4d₁, 4d₂, IVd, Vm, Vd, Vv, 6aes, 6₁, 6₂, b₁₋₄, b₅; setae IVv and b₆, and spine 5 not seen). Setae b₁₋₃, and b₅ dichotomously branched from distal $\frac{1}{3}$. Seta b₅ is much bigger and more branched than in Grygier & Ohtsuka's (1995) pattern.

Cephalothorax-incorporated first pedigerous somite and 3 free succeeding pedigerous somites each bearing pair of biramous swimming legs. Intercoxal sclerites rectangular. Basis diagonally articulating with large, rectangular coxa. Basis with lateral hair-like seta on legs 1–4; on leg 3 this seta at least 2 times longer and noticeably thicker than on other legs, lightly setulated. Swimming leg setae all biserially plumose. Endopodites and exopodites of legs 1–4 triarticulated. Third exopodal segment of legs 1–4 with row of finely spiniform cu-

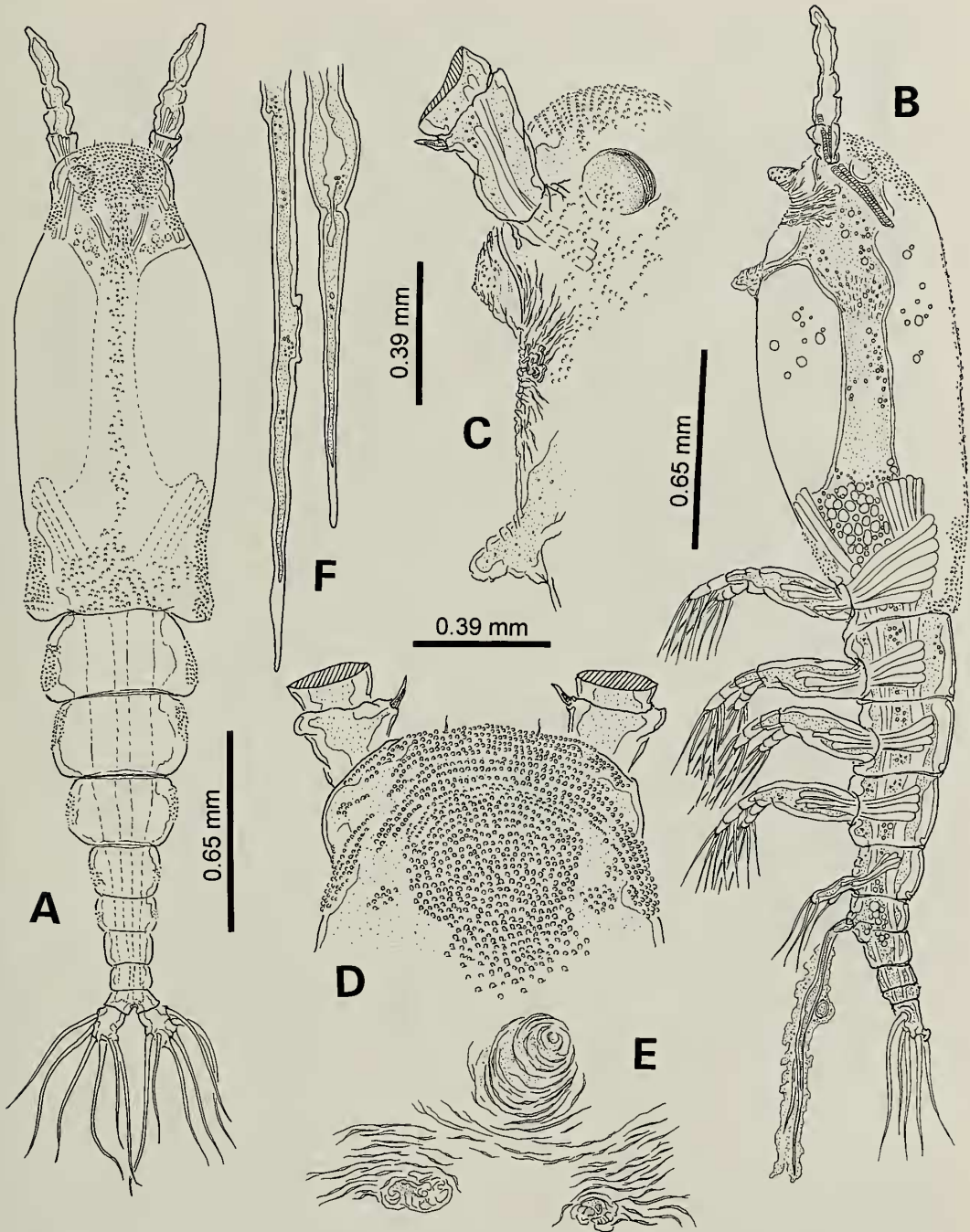


Fig. 1. *Monstrilla pustulata*, n. sp., holotype adult female: A, habitus, dorsal view; B, habitus, lateral view, lateral pustular ornamentation not shown; C, head, lateral view of paratype variant form, showing different shape of frontal cone. D, head, dorsal view, showing cuticular ornamentation; E, details of frontal conical process and related paired nipple-like ornamental structures, ventral view.

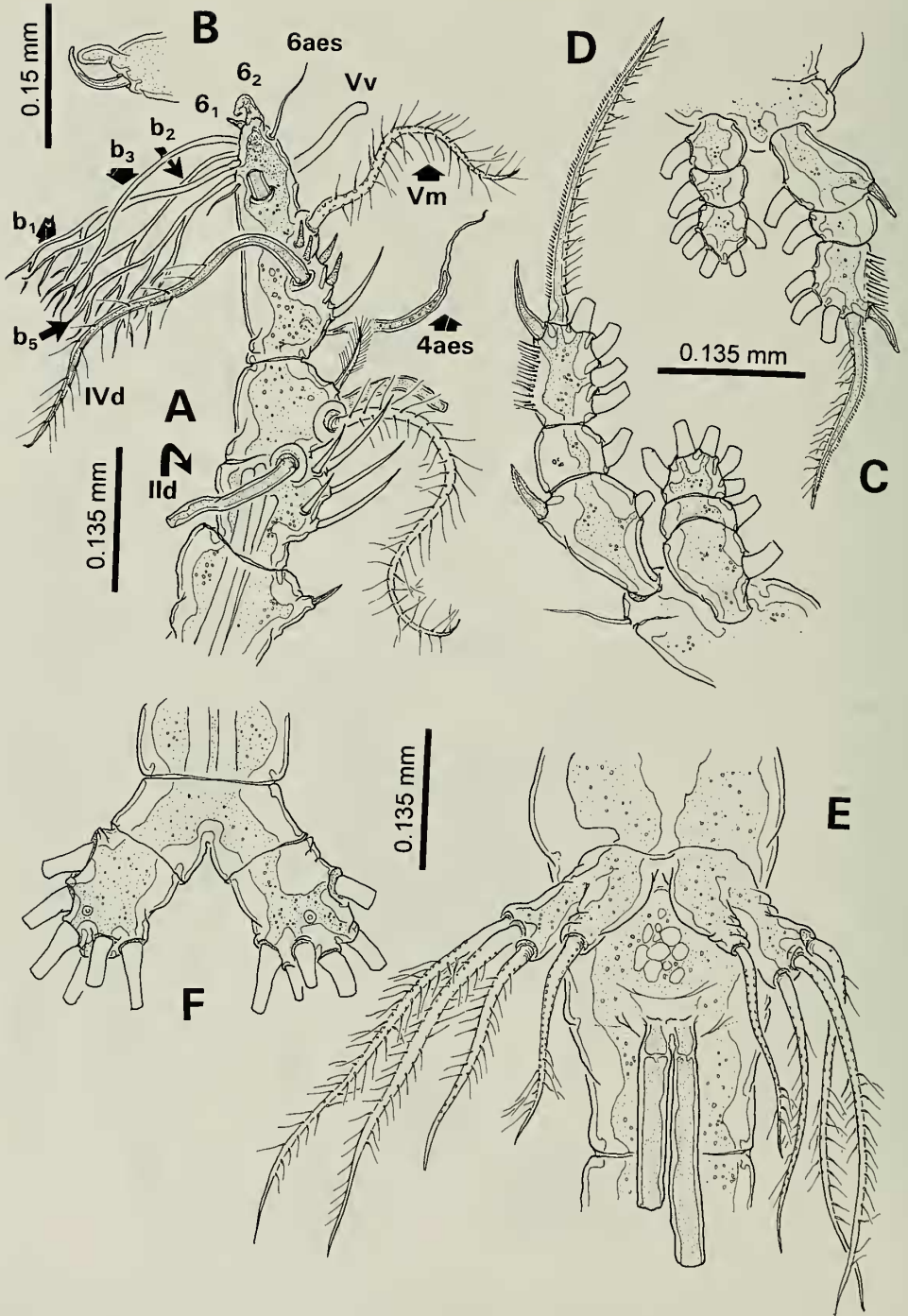


Fig. 2. *Monstrilla pustulata*, n. sp. holotype: A, left antennule, dorsal view; B, detail of pincer-like structure formed by terminal elements of antennule; C, first swimming leg, most setae cut short; D, fourth swimming leg, most setae cut short; E, fifth leg and double genital somite showing insertion of ovigerous spines, ventral view; F, caudal rami, dorsal view, setae cut short.

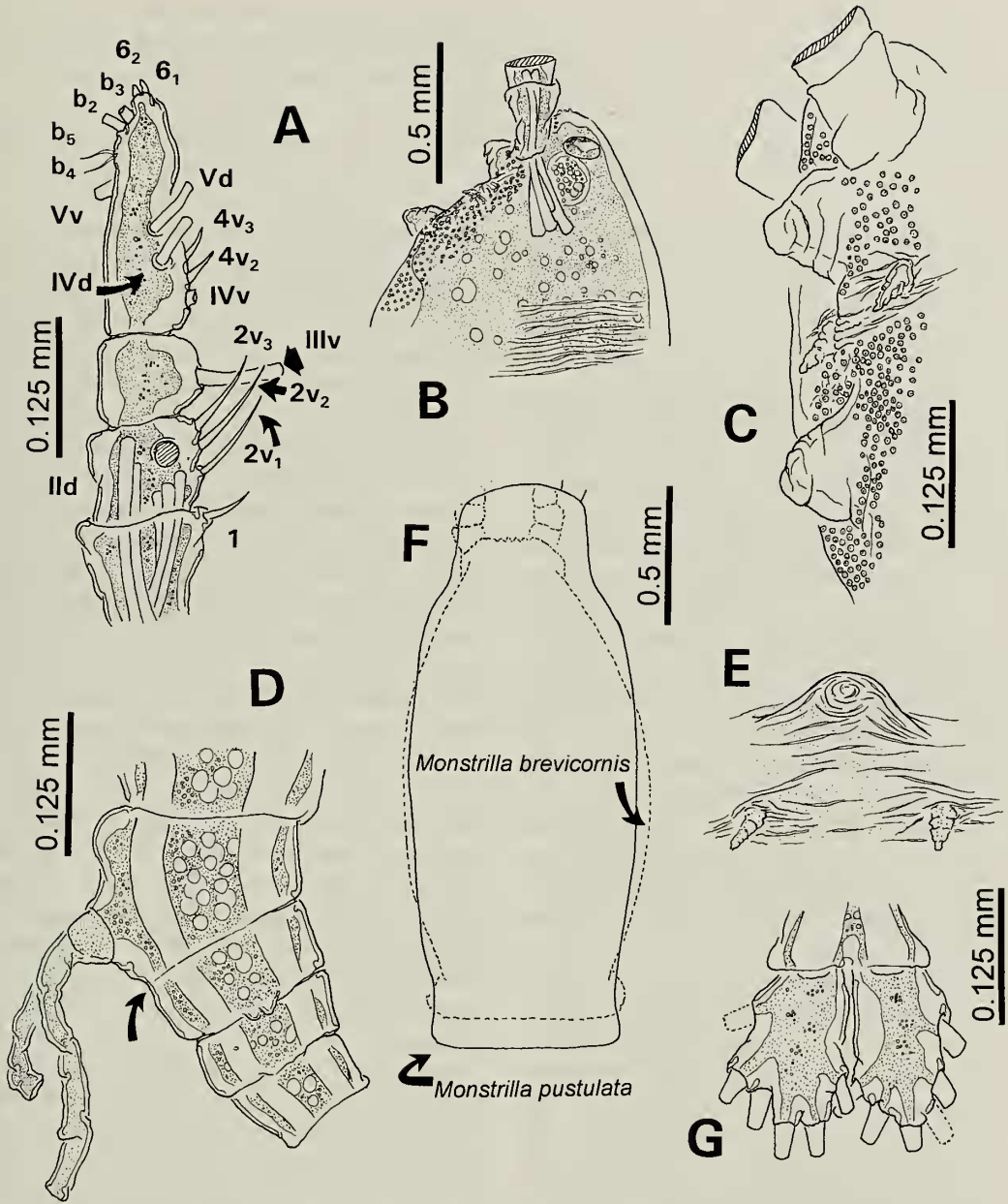


Fig. 3. *Monstrilla brevicornis*, holotype: A, left antennule, dorsal view, showing armature as nomenclature by Grygier & Ohtsuka (1995); B, head, lateral view; C, detail of head showing cuticular ornamentation; D, genital double somite, lateral view, complete suture arrowed; E, detail of ventral horn-like protuberance and nipple-like processes; F, comparative dorsal profiles of cephalothorax of *Monstrilla brevicornis* (broken line) and *M. pustulata*; G, Caudal rami, dorsal view, showing probable position of missing setae (broken lines).

Table 1.—Armature of the basis, endopodite and exopodite of *Monstrilla pustulata*, new species.

	Basis	Endopodite	Exopodite
Leg 1	1-0	0-1; 0-1; 1, 2, 2	I-1; 0-1; I, 1, 3
Legs 2-4	1-0	0-1; 0-1; 1, 2, 2	I-1; 0-1; I, 1, 2, 2

ticular processes on outer margin. Outermost terminal spiniform seta of exopod slightly curved, 2.6–3.4 times as long as bearing segment, armed with row of spines along outer margin; spines become progressively smaller toward distal part of seta, inner margin lightly setulated (Figs. 2C, D). Outer terminal spine of exopod of swimming legs 1–4 curved, relatively long, between 0.7 and 0.8 as long as bearing segment. Armature of swimming legs as in Table 1. Fifth legs bilobed, fused medially at base. Basal portion relatively short as measured from ventral anterior end of its somite. Outer lobe about 1.2 times thicker than inner lobe, armed with 3 long, lightly setulated setae, two outer ones subequal in length and breadth, innermost noticeably (34%) shorter. Inner lobe slender, cylindrical, armed with single seta as long as innermost one of outer lobe (Fig. 2E). All setae biserially setulated. Setae of fifth legs reaching about $\frac{3}{4}$ length of genital double somite.

Urosome consisting of fifth pedigerous somite, genital double somite, one free abdominal somites, and anal somite. Pedigerous somites 2–4 accounting for 26.7% of total length in dorsal view. Urosome, excluding caudal rami, accounting for 19.3% of total body length. Genital double somite with partial intersegmental division, visible in dorsal and lateral views; double somite representing less than half (38%) of length of urosome (Fig. 1B). Ratio of length of fifth pedigerous somite, genital double somite, and free abdominal somite: 30.6: 38: 14.8: 16.6 = 100. Medial portion of genital double somite flat, bearing relatively long, basally separated ovigerous spines, slender in distal one third but slightly swollen distally (Fig. 1F), one slightly longer than the

other. Ovigerous spines representing about 30% of total body length, extending slightly beyond setae of caudal rami. Caudal rami short, subquadrate, about as long as wide, moderately divergent, bearing six setae: two lateral, three terminal, one dorsal (Fig. 2F).

Variability.—One (ECO-CHZ-00518) of the two paratype specimens with reduced pattern of pustular patches relative to the holotype, only about half the surface covered by the patch in the holotype is covered in the paratype. Another difference is a lower frontal cone (see Fig. 1C).

Type locality.—Guanabara Bay (Rio de Janeiro, Brazil) (22°54.604'S; 43°08.988'W). Water column. Depth average: 50 m.

Etymology.—This new species is named using an adjectival derivative of the Latin term *pustula* meaning blister or bubble, *pustulatus* meaning blistered, and using the feminine form *pustulata*. The epithet refers to the peculiar cuticular ornamentation of the species, formed by patches of minute, bubble-like processes, not reported in any other previously known species of *Monstrilloida*.

Remarks.—The female specimens of this new species can be easily included in the genus *Monstrilla* because of the presence of two somites between the anal and the double genital somites (Isaac 1975). This species is morphologically similar to *M. brevicornis* Isaac, 1974a, described from material collected in the Java Sea off Indonesia (Isaac 1974a), and they may be closely related. They both share a character not commonly found in any other species of *Monstrilla*: a high conical ventral process between the oral papilla and the antennular bases. Another species of *Monstrilla* with a long conical process is *M. spinosa* Park,

1967, but it differs strongly from these two species in several other important characters. The general body shape and proportions are also very much alike, and based on the draft illustrations of Isaac (1974a, 1974b), the Brazilian specimens would be identified as *M. brevicornis*. This species is not mentioned in Isaac's (1975) key to the Monstrilloida.

We have examined the adult female holotype specimen of *Monstrilla brevicornis*, collected at Bangka Strait, Java Sea, Indonesia. Plankton sample, leg. Prinz Adalbert, determined by M. J. Isaac, 1973. Deposited in the Museum für Naturkunde Berlin, under catalogue number 15 698.

The new species shows several characters which vary from the holotype of *M. brevicornis*. Although in both species the cephalothorax is robust, its length/width (at widest point) proportions differ: 1.9 in *M. brevicornis* vs. 2.3 in *M. pustulata*. Hence, the cephalothorax of the new taxon is more slender and longer than the clearly oblong, wider shape of *M. brevicornis* (see Fig. 3F).

The cuticular ornamentation of the head is considered to be a useful character to differentiate species of *Monstrilla* (Suárez-Morales & Gasca 1998). In the new species the ornamentation pattern is peculiar, with a large patch of blister-like processes on the dorsal surface of the cephalic region, patches on the lateral margins of the pedigerous somites (see Fig. 1), and a linear patch along the dorsal surface of the cephalothorax. In *M. brevicornis* the ornamentation is entirely different, mainly with transverse cuticular lines around the anterior $\frac{1}{3}$ of the cephalothorax and near the oral papilla. There is also a pattern of uniformly arranged, small, button-like ornamentations on most of the antero-ventral surface; they are arranged in a tighter pattern near the oral papilla (Fig. 3C). The front is roughly corrugated in *M. brevicornis*, whereas it is covered with cuticular blisters in *M. pustulata*. In both species the conical process is as high as the oral papilla, but it seems to be located closer to the antennule bases

in *M. brevicornis* than it is in the new species.

Both species have nipple-like processes on the ventral surface between the conical process and the oral papilla; however, these structures differ substantially between the two species. In *M. brevicornis* they are very long and digitiform, and they clearly protrude from the ventral surface profile in lateral view. In the new species these structures have a different cuticular pattern of ridges, are almost flat, and barely noticeable in lateral view (see Figs. 1B, C). One of the most important differences between both species is the arthrodial membrane separating the posterior the posterior thoracic somite and anterior abdominal somite. It is complete in *M. brevicornis*, whereas it is incomplete in the new species, not reaching the ventral surface.

The antennules of *M. brevicornis* represent about 18% of the body length, whereas this figure is 16% in *M. pustulata*. The terminal spines of the distal segment of the new species are clearly forming a pincer-like structure (see Fig. 2A); in *M. brevicornis* both spines are short, and they do not form such kind of structure.

In the swimming legs, the outer margin of the exopods have long hair-like cuticular processes in the new species but this margin is naked in *M. brevicornis*. The terminal spiniform seta of the distal exopodal segment is different in both: in the new species the inner margin bears thin setules (see Figs. 2C, D), whereas it is naked in *M. brevicornis*. The fifth legs of the holotype of *M. brevicornis* are incomplete, they seem to have originally had two lobes, but only the outer one is now present. Two lobes are clearly present in the new species, the inner one armed with a single seta. Due to the morphological similarity of both species, it is expected that *M. brevicornis* shares the same condition, but this can't be verified until more specimens of *M. brevicornis* become available. The terminal setae of the outer lobe of the fifth leg in *M. brevicornis* are widely separated from each other and

are markedly divergent; in the new species these setae are not divergent and show a tighter placement along the terminal margin of the fifth leg. Another character in which the two species differ is the shape and proportions of the caudal rami. These are quadrate, as long as wide, in *M. pustulata* but clearly rectangular (1.85 longer than wide) in *M. brevicornis*. Although Isaac (1974a, 1974b) illustrated six setae on both furcal rami, we could only find five on the holotype; the new species bears six setae on each caudal ramus. It is probable that a seta of each side was lost during handling and or examination (see Fig. 3G).

The new species also shows some affinities with *M. turgida* A. Scott, 1909 such as the robust shape of the cephalothorax and the bilobed fifth leg with a three outer and one inner setae. However, besides the peculiar conical process shown by *M. pustulata*, these two species can be distinguished by the detailed structure of the fifth legs. In the new species the legs have a short basal part, whereas the base is much longer and slenderer in *M. turgida*. The fifth leg's inner lobe is longer than the outer lobe in *M. turgida*, but it is shorter in *M. pustulata*. The ovigerous spines in *M. turgida* are long, equal to about 60% of the total body length, whereas they are much shorter in the new species, representing around 30% of the body length. Furthermore, the ovigerous spines of *M. turgida* are distinctly pointing anteriorly; this feature was considered by Grygier & Ohtsuka (1997) to be one of the main characters to define a genus level group of species within the Monstrilloida.

As mentioned above, the original description of *M. brevicornis* is incomplete and comments are provided here as a complementary description of this species. The cephalothorax is laterally expanded in dorsal view, with a wide oblong shape, 1.9 times longer than wide (Fig. 3F). The head is relatively wide and tapers abruptly toward the posterior end. The front is coarsely corrugated and no sensillae were observed there. The cuticular ornamentation

consists of a uniform pattern of minute, flat, button-like processes covering most of the dorsal and ventral surfaces of the cephalothorax. The lateral margins of the cephalothorax and the area around the oral papilla have transverse, parallel cuticular ridges (Fig. 3B). On the ventral surface, between the oral papilla and the conical process, this species has a pair of protruding digitiform nipple-like processes surrounded by an irregular pattern of cuticular ridges (Figs. 3C, E). The genital double somite has a complete suture and a pair of lateral processes on the posterior margin of this compound somite (Fig. 3D).

The antennules represent 18.2% of the total body length, a figure different from the 14% estimated by Isaac (1974a). This difference might be due to the forward position of one of the antennules; our measurement was made on the same observation plane. Due to the generally poor condition of the holotype, most of the antennular armature is lost. Following Grygier & Ohtsuka (1995), the elements found in this specimen are: 1 (first segment); $2v_1$, $2v_2$, $2v_3$, socket of IId (second segment); IIIv (third segment); IVv, $4v_2$, $4v_3$, IVd, IVv, Vd, Vv, 6_1 , 6_2 , bases of b_2 , b_3 , and b_5 , b_6 (see Fig. 3A). Isaac (1974b) mentioned only one terminal spine on the distal segment, it actually has two, but one is broken near the base.

As mentioned by Isaac (1974b), the four pairs of swimming legs show the usual armament pattern of monstrilloid copepods. Here we can add that all swimming setae are lightly and biserially plumose. The small terminal spine on the outer margin of the third exopod is clearly curved as in the new species (see Fig. 2C), and the spini-form are lightly and biserially plumose. The small terminal spine on the outer margin of the third exopod is clearly curved as in the new species (see Fig. 2C), and the spini-form seta next to it has a smooth inner margin. The fifth legs were interpreted by Isaac (1974a, 1974b) as having a single lobe with three setae; however, an inner ramus was

probably present in this specimen, but it is broken. The furcal rami are rectangular and each is armed with five setae only, they are probably six of them as suggested by Isaac (1974a, 1974b) when adding the setae indicated in their corresponding positions as shown by broken lines in Fig. 3G.

This species was originally described from material collected in the Java Sea (Isaac 1974a), and basically the same brief description and illustrations were repeated by Isaac (1974b). As mentioned by Grygier (1995), Isaac (1974a, 1974b) did not compare it with *M. turgida* Scott, 1909, which he mentioned as having similarly short antennules. *Monstrilla brevicornis* differs from *M. turgida* in the shape of the cephalothorax, which is widest at its anterior one-third in the former and at the middle in the latter species. The caudal rami are nearly quadrate in *M. turgida* and clearly rectangular in *M. brevicornis*. The antennules are 35% of the cephalothorax length in *M. turgida* and 25% in *M. brevicornis*. The fifth legs are not fully comparable due to the broken inner part of the holotype of *M. brevicornis*, but the arrangement of the three setae on the fifth leg of *M. turgida* (as depicted by Scott 1909) seems to be tight, whereas they are widely separated at base in *M. brevicornis*. However, the main difference between these two species is the presence of the conical process in *M. brevicornis*, which is absent in *M. turgida*.

Previous records of *Monstrilla* in Guanabara Bay include: *M. cf. reticulata*, *M. rugosa* Davis, 1947, and *M. grandis* Giesbrecht, 1891 (Dias 1996). Thus, *M. pustulata* is the first species of *Monstrilla* described as new from this bay. *Monstrilla grandis* Giesbrecht, 1891, from off Patagonia is the other species first described as new from the southwestern Atlantic Ocean region. There are a few other scattered records of species first described from elsewhere being known in the region (Razouls 1996).

Acknowledgements

We very much appreciate the help of Dr. Charles Oliver Coleman, curator of the Museum für Naturkunde, Berlin, Germany, for making available to us the holotype specimen of *M. brevicornis* through loan 1/2000. We are grateful to the Laboratory of Zooplankton of the Department of Zoology, Institute of Biology, Federal University of Rio de Janeiro (UFRJ) for supporting this project. Our gratitude to the staff members who helped in the field work. Additional zooplankton material was kindly conveyed to us by Dr. Cristina T. Bonecker. Two anonymous reviewers contributed greatly to improve the first version of this work. Drawings were made by the first author.

Literature Cited

- Davis, C. C. 1984. Planktonic Copepoda (including Monstrilloidea). Pp. 67–91 in K. A. Steidinger & L. M. Walter, eds., Marine plankton life cycle strategies. C. R. C. Press, Florida, 324 pp.
- Dias, C. O. 1996. Monstrilloidea (Copepoda) off the Brazilian coast.—Hydrobiologia 324:253–256.
- Giesbrecht, W. Elenco dei Copepodi pelagici raccolti dal tenente di vascello Gaetano Chierchia durante il viaggio della R. Corvetta "Vettor Pisani" negli anni 1882–1885, e dal tenente di vascello Francesco Orsini nel Mar Rosso, nel 1884. Rendiconti delle Sedute della R. Accademia dei Lincei 7 (1st Sem.):474–481.
- Grygier, M. J. 1994a [dated 1993]. Identity of *Thaumatoessa* (= *Thaumaleus*) *typica* Krøyer, the first described monstrilloid copepod.—Sarsia 78:235–242.
- . 1994b. Nomenclature, redescription, and new record from Okinawa of *Cymbasoma morii* Sekiguchi, 1982 (Monstrilloidea).—Hydrobiologia 292/293:23–29.
- . 1995. Annotated chronological bibliography of Monstrilloidea (Crustacea: Copepoda).—Galaxea 12:1–82.
- , & S. Ohtsuka 1995. SEM observation of the nauplius of *Monstrilla hamatapex*, new species, from Japan and an example of upgraded descriptive standards for monstrilloid copepods.—Journal of Crustacean Biology 15:703–719.
- , & S. Ohtsuka 1997. An undescribed genus of monstrilloid copepods (Crustacea) with anteriorly pointing genital spines and subthoracic egg brooding. Zoological Science.—13 Suppl.:34.
- Huys, R., & G. Boxshall. 1991. Copepod Evolution. The Ray Society, London, UK, 468 pp.

- Isaac, M. J. 1974a. Monstrilloid copepods in the Zoological Museum, Berlin.—Mitteilungen aus dem Zoologischen Museum in Berlin 50:131–135.
- . 1974b. Studies on planktonic arthropods. Ph.D. thesis. University College of Swansea, Wales. U.K., 146 pp.
- . 1975. Copepoda, Suborder: Monstrilloida.—Fiches d'Identification du Zooplancton 144/145:1–10.
- Razouls, C. 1996. Diversité et répartition géographique chez les Copépodes pélagiques. 2.—Platycopioidea, Misophrioida, Mormonilloida, Cyclopoida, Poecilostomatoida, Siphonostomatoida, Harpacticoida, Monstrilloida.—Annales de l'Institut Océanographique 72:1–149.
- Scott, A. 1909. The Copepoda of the Siboga Expedition. Part I. Free-swimming, littoral and semi-parasitic Copepoda.—Siboga Expeditie 29a:1–323.
- Suárez-Morales, E. 1999. Redescription of the male of *Cymbasoma tumorifrons* (Isaac, 1975) from the Mediterranean Sea (Copepoda: Monstrilloida).—Arthropoda Selecta 8:67–71.
- , & R. Gasca. 1998. *Cymbasoma bowmani* sp. nov., a new monstrilloid (Copepoda: Monstrilloida) from a Caribbean reef, with notes on species variation.—Journal of Marine Systems 15:433–439.
- , & N. Riccardi. 1997. Redescription and first record of *Cymbasoma tenue* (Isaac, 1975) (Copepoda: Monstrilloida) in the Mediterranean Sea.—Proceedings of the Biological Society of Washington 110:99–106.